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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/712,945	11/13/2003	Jae Suk Lee	PIA30962/DBE/US	9550
36872	7590	07/26/2006	EXAMINER	
THE LAW OFFICES OF ANDREW D. FORTNEY, PH.D., P.C. 401 W FALLBROOK AVE STE 204 FRESNO, CA 93711-5835			ARENA, ANDREW OWENS	
			ART UNIT	PAPER NUMBER
			2811	

DATE MAILED: 07/26/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

10/712,945

Applicant(s)

LEE, JAE SUK

Examiner

Andrew O. Arena

Art Unit

2811

**– The MAILING DATE of this communication appears on the cover sheet with the correspondence address –**  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 10 July 2006.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 12-20 and 22-29 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 12-20 and 22-29 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
- ☒ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

## **DETAILED ACTION**

### ***Continued Examination Under 37 CFR 1.114***

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 07/10/2006 has been entered.

### ***Claim Rejections - 35 USC § 112***

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 12 and 29 are rejected under 35 U.S.C. 112, first paragraph, because the specification does not reasonably provide enablement for the first metal lines preventing ions of the second metal lines from being diffused into the substrate. The specification (most relevant portions are ¶18, 21, and 22) does not enable any person skilled in the art to practice the invention commensurate in scope with the claims.

It is clear that (Fig 2I), barrier 116 of the second metal lines 120 prevents ions of the second metal 118a from being diffused into the substrate. It is not clear how first metal line 108 can prevent diffusion of ions of the second metal lines into the substrate.

### ***Claim Objections***

Claim 29 is objected to because the recitation "configured to prevent ions..." fails to limit the scope of the claim and renders the claim unclear. It is unclear exactly what structural arrangement meets this limitation. For art-based rejection purposes, all structurally similar arrangements will be regarded as "configured to prevent ions..."

Appropriate correction is required.

### ***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 12, 13, 15, 16, 20, and 25-28 are rejected under 35 U.S.C. 102(e) as being anticipated by Anand (US 6,500,748).

**Regarding claim 12**, Anand discloses (Fig 7; col 6) a metal line structure (col 1 ln 10) formed in a semiconductor device (col 1 ln 9), comprising:

first metal lines (17; ln 27) formed on a substrate (11; ln 8), the first metal lines having a first barrier metal layer (17a; ln 23) and a first conductive layer (17b; ln 29);

a first interlayer insulator (15, 24, 25; ln 12-18) between adjacent ones of the first metal lines;

second metal lines (20; In 50) formed on respective ones of the first metal lines, the second metal lines having a second barrier metal layer (20a; In 46) and a second conductive layer (20b; In 48-49); and

a second interlayer insulator (18, 26, 27; In 36-40) between adjacent ones of the second metal lines;

wherein the first conductive layer is formed of a material (Al-Cu alloy; col 7 In 67) different from a material of the second conductive layer (Cu; col 8 In 67).

**Further regarding claim 12**, In view of the 35 USC § 112, first paragraph issue outlined above, it seems the limitation "the first metal lines prevent ions of the second metal lines from being diffused into the substrate" can be disclosed by neither the applicant nor the prior art. This limitation is still rejected; insofar as Anand discloses applicant's claimed structure, Anand is capable of applicant's claimed function.

**Regarding claim 13**, Anand discloses (Fig 7) each of the first metal lines (17) have a thickness substantially identical to a thickness of the second metal lines (20).

**Regarding claim 15**, Anand discloses (Fig 7) the first interlayer insulator (15+24+25) has a thickness substantially identical to a thickness of the second interlayer insulator (18+26+27).

**Regarding claim 16**, Anand discloses the second conductive layer consists essentially of Cu (col 8 In 66-67).

**Regarding claim 20**, Anand discloses the first and the second barrier metal layers comprise at least Ti (col 7 In 60-62; col 8 In 60-62).

**Regarding claim 25**, Anand discloses the first barrier metal comprises Ti (col 7 In 60-62).

**Regarding claim 26**, Anand discloses the first barrier metal comprises TiN (col 7 In 60-62).

**Regarding claim 27**, Anand discloses the second barrier metal comprises Ta (col 8 In 60-62, "titanium...or the like" recognized in the art to encompass Ta).

**Regarding claim 28**, Anand discloses the second barrier metal comprises TaN (col 8 In 60-62, "titanium nitride...or the like" recognized in the art to encompass TaN).

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Anand as applied to claim 12 above, and further in view of Iwasaki (US 6,856,021).

**Regarding claim 14**, Anand discloses the first conductive layer comprises an Al alloy containing Cu (col 7 In 66-67).

Anand differs from the claimed invention only in not expressly disclosing the composition of the alloy.

Iwasaki discloses (Fig 1) a metal line structure formed in a semiconductor device and teaches an Al-Cu alloy containing not greater than 5% Cu (col 5 ln 3).

It would have been obvious to a person having ordinary skill in the art at the time the invention was made that the first conductive layer of Anand comprises, in view of Iwasaki, an Al alloy containing not greater than 5% Cu; at least to enhance the migration resistance (Iwasaki: col 5 ln 1-3).

Claims 17-19 and 22-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Anand as applied to claim 12 above, and further in view of reference U (cited in previous 892 forms, also provided with the action dated 05/25/2006).

**Regarding claims 17-19 and 22-24**, Anand discloses the first interlayer insulator comprises a silicate glass (15; col 7 ln 19-20) and does not limit the material used for either the first (15, 24, 25) or second (18, 26, 27) interlayer insulator film (col 7 ln 20, ln 27-32, col 8 ln 17-18, ln 23-39).

Anand differs from the claimed invention only in not expressly disclosing "fluorinated silicate glass (FSG)."

Reference U teaches FSG in an analogous structure (pg 2: "Thermal stability study of the interconnect system with fluorinated silicate glass as IMD layers" ln 1-4).

It would have been obvious to a person having ordinary skill in the art at the time the invention was made that the first and second interlayer insulator layers of Anand comprise, in view of reference U, fluorinated silicate glass (FSG); at least to enhance device reliability (reference U line 3-4).

**Further regarding claims 17-19**, the product-by-process limitations:

“deposited by a high density plasma (HDP) process” of claim 17; and

“deposited by a plasma enhanced chemical vapor deposition (PECVD) process”

of claims 18 and 19;

have not been given patentable weight. See MPEP § 2113.

Further regarding claims 27 and 28, if it can be established that “titanium and titanium nitride...or the like” (Anand col 7 ln 60-62 and col 8 ln 60-62) would not be recognized by one of ordinary skill in the art to encompass Ta and TaN, the following alternate ground of rejection applies.

Claims 27 and 28 rejected under 35 U.S.C. 103(a) as being unpatentable over Anand as applied to claim 12 above, and further in view of Huang (US 6,150,073).

**Regarding claims 27 and 29**, Anand discloses the second barrier metal comprises refractory metals and their nitrides (col 8 ln 60-62).

Anand differs from the claimed invention only in not expressly disclosing all encompassed materials.

Huang discloses (Fig 2F) a metal line structure formed in a semiconductor device (col 1 ln 11-15) and the barrier metal layer (208) comprises Ta or TaN (col 3 ln 40-42).

It would have been obvious to a person having ordinary skill in the art at the time the invention was made that the second barrier metal of Anand comprises, in view of Huang, Ta (claim 27) or TaN (claim 28); at least to improve the attachment of the metal layer (Huang: col 3 ln 44-46).



Claim 29 is rejected under U.S.C. 103(a) as being unpatentable over Anand in view of Iwasaki.

**Regarding claim 29**, Anand discloses (Fig 7; col 6) a structure in a semiconductor device (col 1 ln 9), comprising:

first metal lines (17; ln 27) on a substrate (11; ln 8) configured to prevent ions of overlying second metal lines from diffusing into the substrate, the first metal lines having a first barrier metal layer (17a; ln 23) and a first conductive layer (17b; ln 29) comprising an Al alloy containing Cu (col 7 ln 66-67);

a first interlayer insulator (15, 24, 25; ln 12-18) between adjacent first metal lines;

second metal lines (20; ln 50) the first metal lines, the second metal lines having a second barrier metal layer (20a; ln 46) and a second conductive layer (20b; ln 48-49) consisting essentially of Cu (col 8 ln 66-67); and

a second interlayer insulator (18, 26, 27; ln 36-40) between adjacent second metal lines.

Anand differs from the claimed invention only in not expressly disclosing the composition of said alloy.

Iwasaki discloses (Fig 1) a metal line structure formed in a semiconductor device and teaches an Al-Cu alloy containing not greater than 5% Cu (col 5 ln 3).

It would have been obvious to a person having ordinary skill in the art at the time the invention was made that the first conductive layer of Anand comprises, in view of Iwasaki, an Al alloy containing not greater than 5% Cu; at least to enhance the migration resistance (Iwasaki: col 5 ln 1-3).

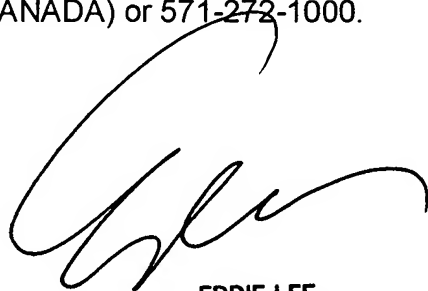
**Conclusion**

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Andrew O. Arena whose telephone number is (571) 272-5976. The examiner can normally be reached on M-F 8:30-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie Lee can be reached on (571) 272-1732. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Andrew O Arena  
20 July 2006



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